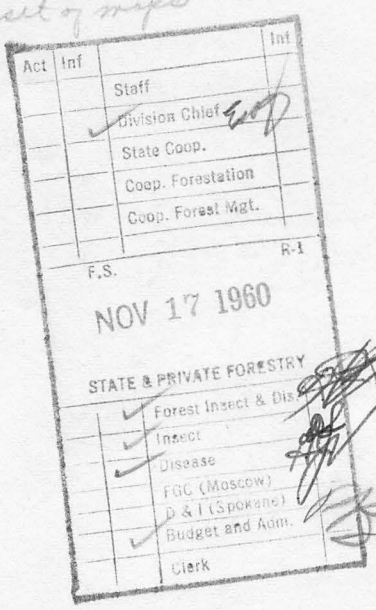
Rough draft attached
6 cc: FIL w/set of maps
5 cc: WO
77 surplus



5240 . 2-1 Gallatin
1960

SUPPRESSION
(1960 Gallatin Control Unit)

Missoula, Montana
November 14, 1960

MEMORANDUM FOR DIVISION CHIEFS AND FOREST SUPERVISORS:

The Gallatin Forest spruce budworm epidemic had not declined in 1959, thus a control project was proposed where tree mortality seemed inevitable. However, only two small areas (Pine Creek Unit and Gallatin River Unit) were approved, because of private land ownership problems.

Attached is a report on the 117,845-acre Gallatin project.

E. H. JUNTUNEN, Chief
Division of State & Private Forestry

By Keith Thompson

Attachment

Bozeman, Montana
November 9, 1960

GALLATIN NATIONAL FOREST

AERIAL SPRAY PROJECT

for

SPRUCE BUDWORM CONTROL

1960

Region 1, U.S.F.S.
Division of S&PF

Table of Contents

	Page
Foreword	
Summary	
Precontrol	1
Contracts	1
Surveys	1
Summary of the Acreage of Control Units by Ownership	1
Control	2
Timing of Spray Application	2
Airport Installations	2 - 3
Insecticide	3
Aerial Phase	3
Summary of Aircraft Used on the Spray Project	3
Deposition of Insecticide	3 - 4
Safety	4
Cooperation	4
Post Control	5
Mortality Checks	5
DDT Studies	5 - 6
Project Costs	6
Appendix	7 - 8

FOREWORD

The current spruce budworm, Choristoneura fumiferana (Clem.) outbreak in Region 1 began in the early 1940's. At present more than 5,000,000 acres are infested in various degrees, and the epidemic shows no evidence of a general decline.

The younger the tree, the more quickly it is killed by the spruce budworm. Heavy localized tree mortality has occurred in the Douglas-fir reproduction and pole stands of the Bitterroot, Deerlodge, Gallatin, Helena, Beaverhead and Lewis & Clark National Forests. Considerable growth losses and some mortality has occurred in mature stands. The current regional mortality and growth losses on lands of all ownerships amounts to several million dollars annually.

The primary objective of control by aerial spraying is to reduce spruce budworm populations thus preventing tree mortality and growth losses until natural factors return budworm epidemics to normal conditions.

Control action was initiated on the Gallatin National Forest in 1955 when 133,000 acres were sprayed in the Upper Yellowstone River drainage near Gardiner, Montana. During 1957 an additional 113,000 acres were successfully sprayed in the Mill Creek area (east of Emigrant, Montana) at a cost of about one dollar per acre.

Operational ground surveys during 1959 showed the spruce budworm infested about 900,000 acres of the Gallatin National Forest. In the spring of 1960 a decision was reached to aerially spray for the first time approximately 120,000 acres of high value recreational and commercial timber stands in the Yellowstone and Gallatin River drainages.

SUMMARY

The Gallatin spruce budworm control project consisted of aerial spraying 117,845 acres of budworm infested timber stands. There were 66,237 acres in the Gallatin River Block, and 51,608 acres in the Pine Creek Block.

Federal land composed 84.6 percent of the area sprayed.

Bid invitations were released on May 7 and opened on May 26, 1960. Final awards were made to Johnson Flying Service Inc., Missoula, Montana, for the spraying and to Herrod Aviation Company of Billings, Montana for the supplying, storage, and loading of the insecticide.

Sixty-six budworm development plots were established at elevations from 4700 to 7100 feet throughout the control area to determine the time for the spraying of each spray block.

All aerial operations were conducted from Gallatin Field at Belgrade, Montana. Spraying commenced on June 30, and was completed on July 13. Five spray planes were used on the project with no more than four operating on any one day.

To minimize damage to fish and aquatic insects, parts of seven spray blocks in the Gallatin drainage containing fishing waters were sprayed with an insecticide containing only one-half pound of DDT per gallon. The remaining areas were sprayed with an insecticide containing one pound of DDT per gallon. All areas were sprayed at the rate of one gallon of insecticide per acre.

Weathermen reported wind and temperature readings throughout the spray period. Spraying was terminated when the wind velocity exceeded six miles per hour or the temperature reached 68° F. Aerial observers also reported on the action of the spray. Spraying operations were halted if the spray broke up or did not settle properly.

Oil sensitized dye cards were used to determine the volume of spray reaching the ground. Respraying was required in areas not properly sprayed.

Budworm mortality counts were made to determine the effectiveness of the spraying. These counts showed an average budworm kill of 97.8 percent in the areas checked.

Very preliminary examinations of post spray fish samples from the Gallatin River drainage indicate all age classes were present.

Aquatic insect and fish mortality occurred in one small, shallow, mud-bottomed lake, but no dead fish were found in side streams or the Gallatin or Yellowstone Rivers.

Fall samples indicate some recovery of aquatic insects in three Gallatin River tributaries where post spray July samples had shown severe losses from DDT spray.

Total cost of the project was $116,132.32 or $0.9855 per acre sprayed.

PRECONTROL

Contracts

On May 7, 1960 bids were solicited for the spraying of approximately 120,000 acres of budworm infested timber on the two control units. The estimated average flight distance from Gallatin Field at Belgrade, Montana to both spray units was 37 miles. In addition to spraying this area, the bidder was required to provide two four-place observation planes.

Bids were opened at Missoula, Montana on May 26, 1960 and the spraying contract was awarded to Johnson Flying Service, Inc., Missoula, Montana. The bid price was $0.208 per acre sprayed, with two observation planes being provided at $25.00 each per flight hour.

On the same dates, bids were requested and opened for the furnishing of 120,000 gallons of insecticide and facilities for the storing and loading of the insecticide into spray planes at Gallatin Field. Specifications called for 107,000 gallons of the insecticide to contain one pound of DDT per gallon of spray and 13,000 gallons to contain one-half pound of DDT per gallon. This contract was awarded the Herrod Aviation Company of Billings, Montana on June 3, 1960. The bid price was $0.3677 per gallon for insecticide containing one-half pound of DDT per gallon and $0.4833 per gallon for the insecticide containing one pound of DDT per gallon.

Surveys

During the fall of 1959 and the spring of 1960, surveys were made to determine the exterior boundary of the two control units. These units were then broken up into 41 spray blocks with 24 blocks in the Gallatin Unit and 17 in the Pine Creek Unit. Blocks were then delineated on aerial mosaics and the land ownership and acreage for each block determined. Acreages for each section were checked against G.L.O. plats.

Financial cooperation was solicited from all private landowners within the project boundary. Private lands within the units totaled 16,643 acres or 14.1 percent of the total spray acreage.

Summary of the Acreage of Control Units by Ownership

Unit	Federal	State	Private	Total
Gallatin Block	60,847	90	5,300	66,237
Pine Creek Block	38,875	1,390	11,343	51,608
Total	99,722	1,480	16,643	117,845
Percentage	84.6%	1.3%	14.1%	100%

pilot briefing, and first aid. Flying time, insecticide loading and weather records were kept in a house trailer located fronting on the flight line. Radio and telephone communications were also located in this trailer. A parking lot for vehicles was provided outside the work area.

Insecticide

The insecticide contractor, Herrod Aviation Company, set up his own mixing plant adjacent to the storage tanks at the airport. Finished insecticide offered to the Forest Service was pumped into secondary storage tanks until the material had been checked for contract specifications by chemists at Montana State College. Accepted finished insecticide was then pumped into primary storage tanks connected directly to the spray plane loading pumps.

Difficulty was encountered by the contractor in meeting the plus or minus 1% specification on DDT content as set up in the contract. Problems encountered were thought to be mainly due to the solvent (Cycle oil) furnished the contractor. Specific gravity of this material was not constant and made accurate mixing difficult. It might be well to liberalize this specification to plus or minus 2% in future insecticide contracts.

Aerial Phase

Five planes owned by Johnson Flying Service, Inc., were used for spraying on the project. In addition, two Cessna observation planes leased by Johnson from Flight Lines, Incorporated, flew 93 hours during the project.

A total of 160 flights were flown during the 12 spraying days between June 30 and July 13. On normal days, the spray planes left on their first flight at approximately 4:00 a.m. and spraying was usually terminated between 8:00 and 9:00 a.m.

Summary of Aircraft Used on the Spray Project

Type plane	Plane no.	Pilot name	Days used	No. of trips	Ave. gal. per trip	Gallons* sprayed
TBM	N7014C	Culver	10	49	733	35,897
TBM	N7016C	Musgrove	10	41	727	29,803
TBM	N3249G	Roth	6	29	735	21,304
Ford	N9912	Nelson	8	22	450	9,888
DC-3	N49466	Roth	5	19	1177	22,359

Deposition of Insecticide

Each day, after spraying operations were completed, the aerial observers briefed the spray plane pilots on the areas to be sprayed the following day. Orientation flights and photo mosaics were used during these briefings; each pilot was instructed in the number of gallons of insecticide to be applied to his block. Flight hazards were pointed out as were emergency landing fields. Pilots were also briefed on alternate areas to be sprayed in case weather conditions were poor in the scheduled spray blocks.

* Includes areas resprayed and losses.

Montana State Fish & Game Department - cooperated in studies on the effect of DDT on fish, aquatic insects and deer.

Montana State College - assigned a member of the chemistry department to run tests to check the quality of all insecticide used.

Forest Insect Laboratory, U.S.F.S. - provided technical advice on the entomological phases of the program. They also trained the aerial observers.

Division of Administrative Services, U.S.F.S. - prepared the invitations to bid on the supplying of insecticide and for the aerial spraying.

Division of Fire Control, U.S.F.S. - supplied smokejumpers to serve as spray deposit and mortality checkers. They also calibrated the spray planes and supplied the air safety officer at the airport.

Division of Information and Education, U.S.F.S. - prepared news releases for radio and newspapers.

Wildlife Research Center and Fish Pesticide Laboratory, U.S. Bureau of Sport Fisheries and Wildlife - conducted research studies on the effect of DDT on deer and fish, respectively.

POST CONTROL

Mortality Checks

So that mortality directly attributable to the aerial spraying could be computed, a budworm population sample was taken immediately prior to and 10 days after the spraying of each block. Comparison of the living budworm population before and after spraying provided a fairly accurate estimate of the percentage of mortality occurring in an area. Mortality counts were taken in 64 percent of the blocks sprayed.

Budworm mortality averaged 97.8 percent for the project. (See tables in Appendix).

DDT STUDIES

Studies were conducted by the U.S. Fish and Wildlife Service, Montana State Fish & Game Department and the U.S. Forest Service. To evaluate the effects of DDT on fish and aquatic insects, the Montana State Fish & Game Department and the Forest Service took prespray fish and aquatic insect samples respectively, in the fall of 1959 and post spray samples in 1960. Prespray and post spray deer samples were taken by the Game Department.

APPENDIX

Gallatin Unit

Block no.	Block name	Acres	Date released	Date sprayed	Card lines	Mortality
1 *	Shenango	645	6/29	7/9	.21	100
2 *	Castle Rock	2,205	7/1	7/5	.32	93.5
3 *	Squaw Creek	1,394	7/4	7/5	.19	-
4	Rat Lake	3,234	7/8	7/9	.12	-
5	Pioneer Lake	2,923	7/9	7/4	.17	98.8
6 *	Swan Creek	834	6/29	7/3	.23	98.9
7	Moose Creek	3,384	7/10	7/13	-	100
8	Tamphrey Cr.	3,032	7/9	7/11	.46	100
9	Goose Creek	3,071	7/9	7/13	-	100
10	Levinski Cr.	3,039	7/9	7/11	.27	99.5
11	North Porcupine	3,346	7/9	7/11	.21	100
12	South Porcupine	4,768	7/10	7/12	-	-
13	Elkhorn Cr.	4,584	7/10	7/12	-	-
14 *	Red Cliff	3,440	6/29	7/2	.27	93.0
15	Lower Buck	3,501	7/5	7/7	.16	100
15-A	Upper Buck	2,893	7/11	7/12	-	-
16	Beaver Cr.	3,531	7/6	7/8	.17	99.5
17 *	Shady Rest	2,192	7/4	7/7	-	96.6
18 *	Karst	2,893	7/4	7/7	.64	100
19	Deer Cr.	2,090	7/6	7/9	.18	95.7
20	Asbestos	2,779	7/8	7/9	.23	-
21 *	Cave Cr.	3,317	6/30	7/11	.38	99.3
22	Porcupine	1,191	7/5	7/9	.16	-
23	Cinnamon	600	7/9	7/12	-	100
24	Smith	1,350	7/7	7/8	-	-
		66,237				98.7%

* Parts of these blocks were treated with one-half pound insecticide.

RI-6240-3

JCB NO. .....

REQUISITION FOR STENOGRAPHIC WORK

FOR DIVISION OF S&PF NO. COPIES 140 DATE SUBMITTED 11/14/60 DATE REQUIRED 11/17/60

TYPE OF JOB

- ..... TYPING
- X MIMEOGRAPH
- ..... DITTO
- ..... MULTILITH
- ..... PAPER PLATE
- ..... STENCIL NEGATIVE
- ....

PUNCH

- 5-HOLE
- 3-HOLE
- 2-HOLE

KIND OF PAPER

PLAIN	MIMEO PLAIN	THIN PLAIN
X WHITE	..... WHITE	..... WHITE
..... YELLOW	..... YELLOW	..... YELLOW
..... PINK	..... PINK	..... PINK
..... BLUE	..... BLUE	..... BLUE
..... GREEN	..... GREEN	..... GREEN

LETTERHEAD	MASTHEAD	OTHER
..... BOND	..... SAFETY NEWS	..... DITTO PLAIN
..... THIN	..... R-1 NEWS	..... CARD
..... MIMEO		..... FORM
..... DITTO		

DISTRIBUTION

- X SUPERVISORS (ALL)
- ..... SUPERVISORS AND RANGERS
- X REGIONAL OFFICE DIVISIONS
- ..... OFFICE OF GENERAL COUNSEL
- ..... RESEARCH CENTER
- ..... INTERNAL AUDIT (PORTLAND)
- ..... OTHER REGIONS
- ..... CHIEF, FOREST SERVICE, WO
- ..... WASH. OFFICE, I&E (2 COPIES)
- ..... PUBLICATIONS, I&E, WO (5 COPIES)
- ..... STOCKROOM
- ..... ENCLOSURES
- ..... STENO UNIT

REMARKS? .....

Please return surplus to S&PF.

ASSIGNED TO .....

COMPARED WITH .....

COMPLETED FORM OR SUPP. NO. .....

SAVE MASTERS .....

SEND TO .....

RUN BY .....

DATE DELIVERED .....

DATE DISTRIBUTED .....

BY .....

SURPLUS SENT TO .....

ROUGH DRAFT SENT TO .....

(ALL COMPLETED REQUISITIONS ARE TO BE RETURNED TO THE STENO UNIT.)

Rough draft
DOScott:dvh
11/14/60

5240

Missoula, Montana
November 14, 1960

SUPPRESSION
(1960 Gallatin Control Unit)

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Attached is a report on the 117,845-acre Gallatin project.

E. H. JUNTUNEN, Chief
Division of State & Private Forestry

By Keith Thompson

Attachment

cc: 7 IL (2) attach 1 set of maps
WO (5)
attach other set of maps to SOP file copy

STANDARD FORM NO. 64

Gallatin National Forest
Bozeman, Montana

Office Memorandum • UNITED STATES GOVERNMENT

5240

TO : Regional Forester

DATE: October 27, 1960

FROM : GEO. H. DUVENDACK, Forest Supervisor, By

SUBJECT: Suppression - Spruce Budworm, Gallatin Unit, 1960

Act	Inf		Int
		Staff	
		State Coop.	
		Coop. Forestation	
		Coop. Road Mgt.	

F.S. R-1

OCT 31 1960

STATE & PRIVATE FORESTRY

✓		Forest Insect & Dis.
✓		Insect
		Disease
		FGC (Moscow)
		D & I (Spokane)
✓		Budget and Adm.
		Clerk

Reference is made to Mr. Scott's telephone call on October 24, 1960.

Attached are completed copies of the appendix pages in question. This information was taken from records available here.

Note that according to our records Block 13 "Upper Strawberry" was sprayed. No one here recalls anything different. It was marked off on the mosaic at the spray base as having been sprayed.

Form 3400-2 will be submitted in the near future.

Attachment

PINE CREEK UNIT

Block No.	Block Name	Acres	Date Released	Date Sprayed	Card Lines	Mortality
1	Grosly	3,590	7/6	7/6	.31 .08 R.S.	93.4
2	East Mission	3,460	7/6	7/8	.13	80.5
3	Mill Fork	1,720	7/6	7/6	.23	99.6
4	Mission	3,455	7/4	7/6	.21	94.2
5	Upper Dry Cr.	4,140	7/4	7/3	.17	
6	Lower Dry Cr.	2,864	6/29	7/1	.25 .25	
7	Deep-Suce	5,440	6/29	7/1	.25 .30	99.0
8	Upper Suce	3,364	7/4	7/8	.27	99.1
9	No. Deep Cr.	3,412	7/12	7/13		
10	So. Deep Cr.	1,670	7/8	7/7		
11	Pine-Barney	4,027	7/2	7/1	.18	
12	McDonald	3,932	7/2	7/2	.17	99.1
13	Upper Strawberry	695	7/8	7/7		
14	Kaufmann	3,081	7/2	7/2		
15	Lower Elbow	1,445	7/2	7/5	.05 R .10 R .10 S	100
16	Upper Elbow	3,418	7/7	7/8	.18	
17	Upper Mission	1,905	7/6	7/6	.14	99.1
		51,608				96.0%

APPENDIX

GALLATIN UNIT

Block No.	Block Name	Acres	Date Released	Date Sprayed	Card Lines	Mortality
1 *	Shannango	645	6/29	7/9	.21	100
2 *	Castle Rock	2,205	7/1	7/5	.32	95.5
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Rough draft
11/3/60

GALLATIN NATIONAL FOREST

AERIAL SPRAY PROJECT

for

SPRUCE BUDWORM CONTROL

1960

Bozeman, Montana

November 3, 1960

Table of Contents

	Page
Foreword	
Summary	
Precontrol Project	1
Contracts	1
Surveys	1
Summary of the Acreage of Control Units by Ownership	1
Control	2
Timing of Spray Application	2
Airport Installations	2-3
Insecticide	3
Aerial Phase	3
Summary of Aircraft Used on the Spray Project	3
Deposition of Insecticide	3-4
Safety	4
Cooperation	4
Post Control	5
Mortality Checks	5
DDT Studies	5-6
Project Costs	6
Appendix	7 and 8

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Weathermen reported wind and temperature readings throughout the spray period. Spraying was terminated when the wind velocity exceeded six miles per hour or the temperature reached 68° F. Aerial observers also reported on the action of the spray. Spraying operations were halted if the spray broke up or did not settle properly.

Oil sensitized dye cards were used to determine the volume of spray reaching the ground. Respraying was required in areas not properly sprayed.

Budworm mortality counts were made to determine the effectiveness of the spraying. These counts showed an average budworm kill of 97.8 percent in the areas checked.

Very preliminary examinations of post spray fish samples from the Gallatin River drainage indicate all age classes were present.

Aquatic insect and fish mortality occurred in one small, shallow, mud-bottomed lake, but no dead fish were found in side streams of the Gallatin or Yellowstone Rivers.

Fall samples indicate some recovery of aquatic insects in three Gallatin River tributaries where post spray July samples had shown severe losses from DDT spray.

Total cost of the project was $116,132.32 or $0.9855 per acre sprayed.

PRECONTROL

Contracts

On May 7, 1960 bids were solicited for the spraying of approximately 120,000 acres of budworm infested timber on the two control units. The estimated average flight distance from Gallatin Field at Belgrade, Montana to both spray units was 37 miles. In addition to spraying this area, the bidder was required to provide two four-place observation planes.

Bids were opened at Missoula, Montana on May 26, 1960 and the spraying contract was awarded to Johnson Flying Service Inc., Missoula, Montana. The bid price was $0.208 per acre sprayed, with two observation planes being provided at $25.00 each per flight hour.

On the same dates, bids were requested and opened for the furnishing of 120,000 gallons of insecticide and facilities for the storing and loading of the insecticide into spray planes at Gallatin Field. Specifications called for 107,000 gallons of the insecticide to contain one pound of DDT per gallon of spray and 13,000 gallons to contain one-half pound of DDT per gallon. This contract was awarded the Herrod Aviation Company of Billings, Montana on June 3, 1960. The bid price was $0.3677 per gallon for insecticide containing one-half pound of DDT per gallon and $0.4833 per gallon for the insecticide containing one pound of DDT per gallon.

P R E C O N T R O L

Surveys

During the fall of 1959 and the spring of 1960, surveys were made to determine the exterior boundary of the two control units. These units were then broken up into 41 spray blocks with 24 blocks in the Gallatin Unit and 17 in the Pine Creek Unit. Blocks were then delineated on aerial mosaics

and the land ownership and acreage for each block determined. Acreages for each section were checked against G.L.O. plats.

Financial cooperation was solicited from all private landowners within the project boundary. Private lands within the units totaled 16,643 acres or 14.1 percent of the total spray acreage.

Summary of the Acreage of Control Units by Ownership

Unit	Federal	State	Private	Total
Gallatin Block	60,847	90	5,300	66,237
Pine Creek Block	38,875	1,390	11,343	51,608
Total	99,722	1,480	16,643	117,845
Percentage	84.6%	1.3%	14.1%	100%

C O N T R O L

Timing of Spray Application

Because of the extremely limited period when the aerial application of insecticides can effectively control the budworm, it was most essential that the time of application be precisely determined. Usually spraying can commence in any spray block when sixty percent or more of the budworm population has reached the 5th and 6th instars.

Spruce budworm development varies by spray blocks, control units, exposures, and elevation. Development is usually faster on the warmer slopes most frequently found at lower elevations, on south slopes, or in less dense stands.

To determine the rate of the budworm development, two checking crews were located in the field. Starting on June 20, these development checkers established sampling plots at various elevations and exposures throughout

the control units. Budworm larvae were collected from plots on alternate days, and the percentage of larvae in each instar was then computed. From these figures the biologist was able to determine when each block was ready for spraying.

A total of 66 development plots were established. Thirty of these were permanent plots and from them larvae collections were made every other day. The remaining plots were classed as auxiliary plots and collections were made only when additional information on the budworm development rate in an area was required.

The 30 regular development plots were established at the following elevations:

Low (Under 5500)	Medium (5500-6500)	High (Over 6500)
5	17	8

Several low elevation blocks were released for spraying on June 29, and additional blocks released each day until the final block was released on July 12.

Airport Installations

Use of Gallatin Field was secured from Gallatin County for a $600.00 rental fee plus a tax of one cent a gallon on all aviation gas used during the project. This tax was paid by Johnson Flying Service, Inc. This airport is located 10 miles west of Bozeman and was the nearest large airport to both control blocks.

Operation headquarters were installed next to the taxi strip at the east end of the main runway. Here the insecticide contractor set up his mixing plant

and pumped directly into five storage tanks. These tanks were connected to three aircraft loading stations. Tents were erected for storage, pilot briefing, and first aid. Flying time, insecticide loading and weather records were kept in a house trailer located fronting on the flight line. Radio and telephone communications were also located in this trailer. A parking lot was provided outside the work area for vehicles.

Insecticide

The insecticide contractor, Herrod Aviation Company, set up his own mixing plant adjacent to the storage tanks at the airport. Finished insecticide offered to the Forest Service was pumped into secondary storage tanks until the material had been checked for contract specifications by chemists at Montana State College. Accepted finished insecticide was then pumped into primary storage tanks connected directly to the spray plane loading pumps.

Difficulty was encountered by the contractor in meeting the plus or minus 1% specification on DDT content as set up in the contract. Problems encountered were thought to be mainly due to the solvent (Cycle oil) furnished ~~by~~ the contractor. Specific gravity of this material was not constant and made accurate mixing difficult. It might be well to liberalize this specification to plus or minus 2% in future insecticide contracts.

Aerial Phase

Five planes owned by Johnson Flying Service, Inc., were used for spraying on the project. In addition, two Cessna observation planes leased by Johnson from Flight Lines, Incorporated, flew 93 hours during the project.

A total of 160 flights were flown during the 12 spraying days between June 30 and July 13. On normal days, the spray planes left on their first

flight at approximately 4:00 a.m. and spraying was usually terminated between 8:00 and 9:00 a.m.

Summary of Aircraft Used on the Spray Project

Type Plane	Plane No.	Pilot Name	Days Used	No. of Trips	Ave. Gal. Per Trip	Gallons* Sprayed
TBM	N7014C	Culver	10	49	733	35,897
TBM	N7016C	Musgrove	10	41	727	29,803
TBM	N3249G	Roth	6	29	735	21,304
Ford	N9912	Nelson	8	22	450	9,888
DC-3	N49466	Roth	5	19	1177	22,359

Deposition of Insecticide

Each day, after spraying operations were completed, the aerial observers briefed the spray plane pilots on the areas to be sprayed the following day. Orientation flights and photo mosaics were used during these briefings; each pilot was instructed in the number of gallons of insecticide to be applied to his block. Flight hazards were pointed out as were emergency landing fields. Pilots were also briefed on alternate areas to be sprayed in case weather conditions were poor in the scheduled spray blocks.

During the spraying of an area the planes flew at an elevation of 200 to 475 feet above the tree tops. Spray was released at a rate to give a coverage to one gallon per acre when flown at a pre-determined speed for each type of plane. Aerial observers clocked the spraying time to see that the insecticide was being released at the proper rate. (See tables in Appendix to show spray deposit per block).

* Includes areas resprayed and losses.

Many spray blocks contained popular fishing streams. To reduce the potential damage to fish and aquatic insects in these areas, parts of eight of the spray blocks in the Gallatin Block were sprayed with insecticide containing only one-half pound of DDT per gallon. Area in these sections totaled 12,959 acres.

Weathermen in the spray areas reported the wind velocity and temperature each 15 minutes, starting at 2:45 a.m. Spraying was terminated for the day when the temperature exceeded 68° F. or the wind velocity was greater than 6 miles per hour. Spraying was also stopped if the aerial observers reported the spray was breaking up or not settling properly.

Safety

Prior to the start of the project a safety plan was developed and incorporated into the general operating plan. Safety was stressed at the driver training and biological training schools. The Division of Fire Control detailed an air safety officer to the airport and he saw that all aerial safety requirements were enforced. The biologists enforced high standards of safety in the field and held periodic safety meetings.

There were no injuries to Forest Service or contractor personnel during the project. One aircraft was damaged while spraying but managed to return safely to the airport after dropping its insecticide in a safe remote area. While spraying at proper elevation, the DC-3 was caught in a violent downdraft and the tail hit a rock ridge, knocking off the tail wheel and damaging the elevator. The aircraft was grounded for the rest of the project for repairs.

Cooperation

During the planning and operation of the spray program, many organizations and individuals cooperated to make the project a success. Some of the organizations who assisted were:

Division of State & Private Forestry, U.S.F.S. - provided technical assistance and leadership in precontrol, control, and post control phases of the project. Conducted administrative studies on the effect of DDT on aquatic insects.

Montana State Forester - had the control project area approved as an infestation zone. Contacted and obtained payments for control from large private landowners. Gave local forest officers assistance in contacting small private landowners.

Montana State Fish & Game Department - cooperated in studies on the effect of DDT ~~and~~ on fish, aquatic insects and deer.

Montana State College - assigned a member of the chemistry department to run tests to check the quality of all insecticide used.

Forest Insect Laboratory, U.S.F.S. - provided technical advice on the entomological phases of the program. They also trained the aerial observers.

Division of Administrative Services, U.S.F.S. - prepared the invitations to bid on the supplying of insecticide and for the aerial spraying.

Division of Fire Control, U.S.F.S. - supplied smokejumpers to serve as spray deposit and mortality checkers. They also calibrated the spray planes and supplied the air safety officer at the airport.

Division of Information and Education, U.S.F.S. - prepared news releases for radio and newspapers.

Wildlife Research Center and Fish Pesticide Laboratory, U.S. Bureau of Sport Fisheries and Wildlife - conducted research studies on the effect of DDT on deer and fish, respectively.

POST CONTROL

Mortality Checks

So that mortality directly attributable to the aerial spraying could be computed, a budworm population sample was taken immediately prior to and 10 days after the spraying of each block. Comparison of the living budworm population before and after spraying provided a fairly accurate estimate of the percentage of mortality occurring in an area. Mortality counts were taken in 64 percent of the blocks sprayed.

Budworm mortality averaged 97.8 percent for the project. (See tables in Appendix).

DDT STUDIES

Studies were conducted by the U.S. Fish and Wildlife Service, Montana State Fish & Game Department and the U.S. Forest Service. To evaluate the effects of DDT on fish and aquatic insects, the Montana State Fish & Game Department and the Forest Service took prespray fish and aquatic insect samples, respectively, in the

fall of 1959 and post spray samples in 1960. Prespray and post spray deer samples were taken by the Game Department.

Personnel from the Denver, Colorado, Pesticide Laboratory made intensive studies on fish, aquatic insects and wildlife just prior to spray day and for several weeks following spraying.

Preliminary examinations of post spray fish samples from the Gallatin River drainage indicated all age classes were present, but only an analysis of the data will give a comparative index of fish populations for 1959 and 1960. To date no fish losses in rivers or streams have been reported.

Although precautions were taken, some spray reached a shallow, mud-bottomed lake. Aquatic insects, especially fresh water shrimp populations, were severely damaged. Delayed fish mortality, about a month after spray day, occurred when water temperatures reached 80° F.

Aquatic insect losses were severe in three Gallatin River tributaries. However, fall samples indicated some recovery and near normal numbers are expected by the summer of 1961.

Project Costs

Aerial Spraying @ $0.208 per acre	$24,030.19
Observation Plane Use @ $25.00 per hour	2,327.07
Insecticide - ½ pound DDT per gallon 12,959 gallons @ $0.3677	4,765.02
1 pound DDT per gallon 106,621 gallons @ $0.4833	51,529.93
Less cost of extra solution samples	-95.20
TOTAL	$82,557.01
Gallatin Project Costs	24,075.31
Regional Office Costs	9,500.00
TOTAL COSTS	$116,132.32

A total of 117,845 acres were sprayed at a cost of $0.9855 per acre.

40 copies

GALLATIN NATIONAL FOREST

AERIAL SPRAY PROJECT

for

SPRUCE BUDWORM CONTROL

1960

Bozeman, Montana

Nov. 3

~~August 3~~, 1960

F O R E W O R D

An outbreak of the spruce budworm, Choristoneura fumiferana (Clem.), now current in western Montana and northern Idaho, has spread in extent and severity of resultant tree damage each year since its origin in 1948. At present approximately five million acres are infested and much of the infested area has reached the stage where tree mortality is occurring. In addition to the sawtimber growth losses each year, many small fir and spruce trees in the understory have been killed. Sawtimber growth losses this year will approximate 20 million dollars. If the epidemic continues at its normal rate of spread and intensity, the monetary value of these growth losses will be millions of dollars annually.

Control action was initiated on the Gallatin National Forest in 1955 when 78,000 acres were sprayed in the Upper Yellowstone River drainage near Gardiner, Montana. During 1957 an additional 113,000 acres were successfully sprayed in the Mill Creek area at a cost of one dollar per acre.

Operational ground surveys during 1959 showed the budworm outbreak continuous on about 900,000 acres of the Gallatin National Forest. In the spring of 1960 a decision was reached to aerially spray approximately 120,000 acres in the Yellowstone and Gallatin River drainages to reduce defoliation and resulting tree mortality.

S U M M A R Y

The Gallatin spruce budworm control project consisted of aerial spraying 117,845 acres of budworm infested timber. ~~Part of the area, containing~~ 66,237 acres ~~was~~ in the Gallatin River Block, ~~while the remaining~~ and 51,608 acres was in the Pine Creek Block.

Federal land composed 84.6 percent of the area sprayed.

Bid invitations were released on May 7th and opened on May 26, 1960. Final awards were made to Johnson Flying Service, Missoula, for the spraying and to Herrod Aviation Company of Billings for the supplying, storage, and loading of the insecticide.

Sixty-six budworm development plots were established at elevations from 4700 to 7100 feet throughout the control area to determine the time for the spraying of each spray block.

All ~~flying~~ aerial operations were conducted from Gallatin Field at Belgrade, Montana. Spraying commenced on June 30 and was completed on July 13. Five spray planes were used on the project with no more than four operating on any one day.

To ~~reduce~~ minimize damage to fish and aquatic insects, parts of seven spray blocks in the Gallatin drainage containing fishing streams were sprayed with an insecticide containing only one-half pound of DDT per gallon. The remaining areas were sprayed with an insecticide containing one pound of DDT per gallon. All areas were sprayed at the rate of one gallon of insecticide per acre.

Weathermen reported wind and temperature readings throughout the spray period. Spraying was terminated when the wind velocity exceeded six miles per hour or the temperature reached 68° F. Aerial observers also reported on the action of the spraying ~~which was halted~~ if the spray broke up or did not settle properly.

Oil sensitized dye cards were used to determine the volume of spray reaching the ground. Respraying was required in areas not properly sprayed.

Budworm mortality counts were made to determine the effectiveness of the spraying. These counts showed an average budworm kill of 97.8 percent in the areas checked.

Total cost of the project was $16,132.32 or $0.9855 per acre sprayed.

Contracts

On May 7, 1960 bids were solicited for the spraying of approximately 120,000 acres of budworm infested timber on the two control units. The estimated average flight distance from Gallatin Field at Belgrade, Montana to both spray units was 37 miles. In addition to spraying this area, the bidder was required to provide two four-place observation planes.

Bids were opened at Missoula, Montana on May 26, 1960 and the spraying contract was awarded to Johnson Flying Service, Missoula, Montana. The bid price was $0.208 per acre sprayed, with two observation planes being provided at $25.00 each per flight hour.

On the same dates, bids were requested and opened for the furnishing of 120,000 gallons of insecticide and facilities for the storing and loading of the insecticide into spray planes at Gallatin Field. Specificiations called for 107,000 gallons of the insecticide to contain one pound of DDT per gallon of spray and 13,000 gallons to contain one-half pound of DDT per gallon. This contract was awarded the Herrod Aviation Company of Billings, Montana on June 3, 1960. The bid price was $0.3677 per gallon for insecticide containing one-half pound of DDT per gallon and $0.4833 per gallon for the insecticide containing one pound of DDT per gallon.

P R E C O N T R O L

S u r v e y s

During the fall of 1959 and the spring of 1960, surveys were made to determine the exterior boundary of the two control units. These units were then broken up into 41 spray blocks with 24 blocks in the Gallatin Unit and 17 in the Pine Creek Unit. Blocks were then delineated on aerial photo mosaics and the land ownership and acreage for each block determined. Acreages for each section were checked against G.L.O. plats. Financial cooperation was solicited from all private landowners within the project boundary. Private lands within the units totaled 16,643 acres or 14.1 percent of the total spray acreage.

Summary of the Acreage of Control Units by Ownership

Unit	Federal	State	Private	Total
Gallatin Block	60,847	90	5,300	66,237
Pine Creek Block	38,875	1,390	11,343	51,608
Total	99,722	1,480	16,643	117,845
Percentage	84.6%	1.3%	14.1%	100%

Spruce budworm development varies by spray-blocks, control units ~~and~~ exposures, and elevation.

C O N T R O L

Timing of Spray Application

Because of the extremely limited period when the aerial application of insecticides can effectively control the budworm, it was most essential that the time of application be precisely determined. Usually spraying can commence in any spray block when sixty percent or more of the budworm population has reached the 5th and 6th instars.

Budworm development may proceed more rapidly in some parts of the same block; in some blocks than in others; and in some control units than others. Development is usually faster on the warmer slopes most frequently found at lower elevations, on south slopes, or in less dense stands.

To determine the rate of the budworm development, two checking crews were located in the field. Starting on June 20th these development checkers established sampling plots at various elevations and exposures throughout the control units. Budworm larvae were collected from plots on alternate days, and the percentage of larvae in each instar was then computed. From these figures the biologist was able to determine when each block was ready for spraying.

A total of 66 development plots were established. Thirty of these were permanent plots and from them larvae collections were madeevery other day. The remaining plots were classed as auxiliary plots and collections were made only when additional information on the budworm development rate in an area was required.

The thirty regular development plots were established at the following elevations:

Low (Under 5500)	Medium (5500-6500)	High (Over 6500)
5	17	8

Several low elevation blocks were released for spraying on June 29th, and additional blocks released each day until the final block was released on July 12th.

Airport Installations

Use of Gallatin Field was secured from Gallatin County for a $600.00 rental fee plus a tax of one cent a gallon on all gas used during the project. This tax was paid by Johnson Flying Service, Inc. This airport is located ten miles west of Bozeman and was the nearest large field airport to both of the control blocks.

Operation headquarters were installed next to the taxi strip at the east end of the main runway. Here the insecticide contractor set up his

mixing plant and pumped directly into five storage tanks. These tanks were connected to three aircraft loading stations. Tents were erected for storage, pilot briefing, and first aid. Flying time, insecticide loading and weather records were kept in a house trailer located fronting on the flight line. Radio and telephone communications were also located in this trailer. A parking lot was provided for vehicles of employees and visitors outside the work area.

Insecticide

The insecticide contractor, Herrod Aviation Company, set up his own mixing plant adjacent to the storage tanks at the airport. Finished insecticide offered to the Forest Service was pumped into storage tanks and sealed until the material had been checked for contract specifications by chemists at Montana State College. Accepted insecticide was then connected directly to the spray plane loading pumps.

Difficulty was encountered by the contractor in meeting the specifications on DDT content as set up in the contract. Problems encountered were thought to be mainly due to the solvent (Cycle oil) furnished by the Continental Oil Company to the contractor. Specific gravity of this material was not constant and made accurate mixing difficult.

Aerial Phase

Five planes owned by Johnson Flying Service, Inc. were used for spraying on the project. In addition, two Cessna observation planes leased by Johnson from Flight Lines, Incorporated flew 93 hours during the project.

A total of 160 flights were flown during the 12 spraying days between June 30th and July 13th. On normal days, the spray planes left on their first flight at approximately 4:00 a.m. and spraying was usually terminated between 8:00 and 9:00 a.m.

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Type Plane	Plane No.	Pilot Name	Days Used	No. of Trips	Ave. Gal. Per Trip	Gallons* Sprayed
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Ford	N9912	Nelson	8	22	450	9,888
DC-3	N49466	Roth	5	19	1177	22,359

* Includes areas resprayed and losses.

Deposition of Insecticide

Each day, after spraying operations were completed, the aerial observers briefed the spray plane pilots on the areas to be sprayed the following day. Orientation flights and photo mosaics were used during these briefings; each pilot was instructed in the number of gallons of insecticide to be applied to his block. Flight hazards were pointed out as were emergency landing fields. Pilots were also briefed on alternate areas to be sprayed in case weather conditions were poor in the scheduled spray blocks.

During the spraying of an area the planes flew at an elevation of 200 to 475 feet above the tree tops. Spray was released at a rate to give a coverage of one gallon per acre containing one pound of DDT when flown at a predetermined speed for each type of plane. Aerial observers clocked the spraying time to see that the insecticide was being released at the proper rate. (See tables in Appendix to show spray deposit per block).

Many spray blocks contained popular fishing streams. To reduce the potential damage to fish and aquatic insects in these areas, parts of eight of the spray blocks in the Gallatin Block were sprayed with insecticide containing only one-half pound of DDT per gallon. Area in these sections totaled ~~13,000~~ 12,959 acres.

Weathermen in the spray areas reported the wind velocity and temperature each 15 minutes, starting at 2:45 a.m. Spraying was terminated for the day when the temperature exceeded 68° F. or the wind velocity was greater than 6 miles per hour. Spraying was also stopped if the aerial observers reported the spray was breaking up or not settling properly.

Safety

Prior to the start of the project a safety plan was developed and incorporated into the general operating plan. Safety was stressed at the driver training and biological crews training schools. Al Hammond served as air safety officer at the airport and saw that all aerial safety requirements were enforced. The biologists enforced high standards of safety in the field and held periodic safety meetings.

There were no injuries to Forest Service nor contractor personnel during the project. One aircraft was damaged while spraying but managed to return safely to the airport after dropping its insecticide in a safe remote area. While spraying at proper elevation, the DC-3 was caught in a violent downdraft and the tail hit a rock ridge, knocking off the tail wheel and damaging the elevator. The aircraft was grounded for the rest of the project so that proper repairs could be made.

Cooperation

During the planning and operation of the spray program, many organizations and individuals cooperated to make the project a success. Some of the organizations who assisted were:

Montana State Forester - ~~assisted in having~~ Had the control project area approved as an infestation zone.* Gave local forest officers assistance in contacting small private land owners. → Contacted and obtained payments for control from large private landowners.

Montana State Fish and Game Department - cooperated in studies of the effect of DDT on fish, and deer. aquatic insects

Montan State College - assigned a member of the chemistry department to run tests to check the quality of all insecticide used.

Forest Insect Laboratory, U.S.F.S. - provided technical advice on the entomological phases of the program. ~~Tom T. Terrell~~ They also trained the aerial observers.

Division of Administrative Services, U.S.F.S. - prepared the invitations to bid on the supplying of insecticide and for the aerial spraying.

Division of Fire Control, U.S.F.S. - supplied smokejumpers to serve as spray deposit and mortality checkers. ~~Al Hammond~~ They also calibrated the spray planes and ~~served as~~ supplied the air safety officer at the airport.

Division of Information and Education, U.S.F.S. - prepared news releases for radio and newspapers.

Division of State and Private Forestry, U.S.F.S. - provided technical assistance and leadership in precontrol, ~~and~~ control, post control phases of the project. Conducted administrative, ~~aquatic~~ studies on the effect of DDT on aquatic insects.

Wildlife Research Center and Fish Pesticide Laboratory, U. S. Bureau of Sport Fisheries and Wildlife conducted ~~research~~ research studies on the effect of DDT on ~~fish, aquatic~~ deer and fish, respectively.

POST CONTROL

Mortality Checks

So that mortality directly attributable to the aerial spraying could be computed, a budworm population sample was taken immediately prior to and 10 days after the spraying of each block. Comparison of the living budworm population before and after spraying provided a fairly accurate estimate of the percentage of mortality occurring in an area. Mortality counts were taken in 64 percent of the blocks sprayed.

Budworm mortality averaged 97.8 percent for the project. (See tables in Appendix).

Project Costs

Aerial Spraying @ $0.208 per acre	~~$24,397.98~~ $24,030.19
Observation Plane Use @ $25.00 per hour	2,327.07
Insecticide - ½ pound D.D.T. per gallon 12,959 gals. @ $0.3677	4,765.02
1 pound D.D.T. per gallon 106,621 gals. @ $0.4833	51,529.93
Less cost of extra solution samples	- 95.20
TOTAL	~~$56,199.75~~ 92,557.01
Gallatin Project Costs	24,075.31
~~Mileage~~	
Regional Office Costs	9,500.00
TOTAL COSTS	116,132.32

A total of 117,845 acres were sprayed at a cost of $0.985 per acre. Of these 12,959 acres were sprayed with one gallon of insecticide containing one-half pound of DDT at a cost of $0.8699 per acre. The remaining 104,886 acres were sprayed with one gallon of insecticide containing one pound of DDT at a cost of $0.9998 per acre.

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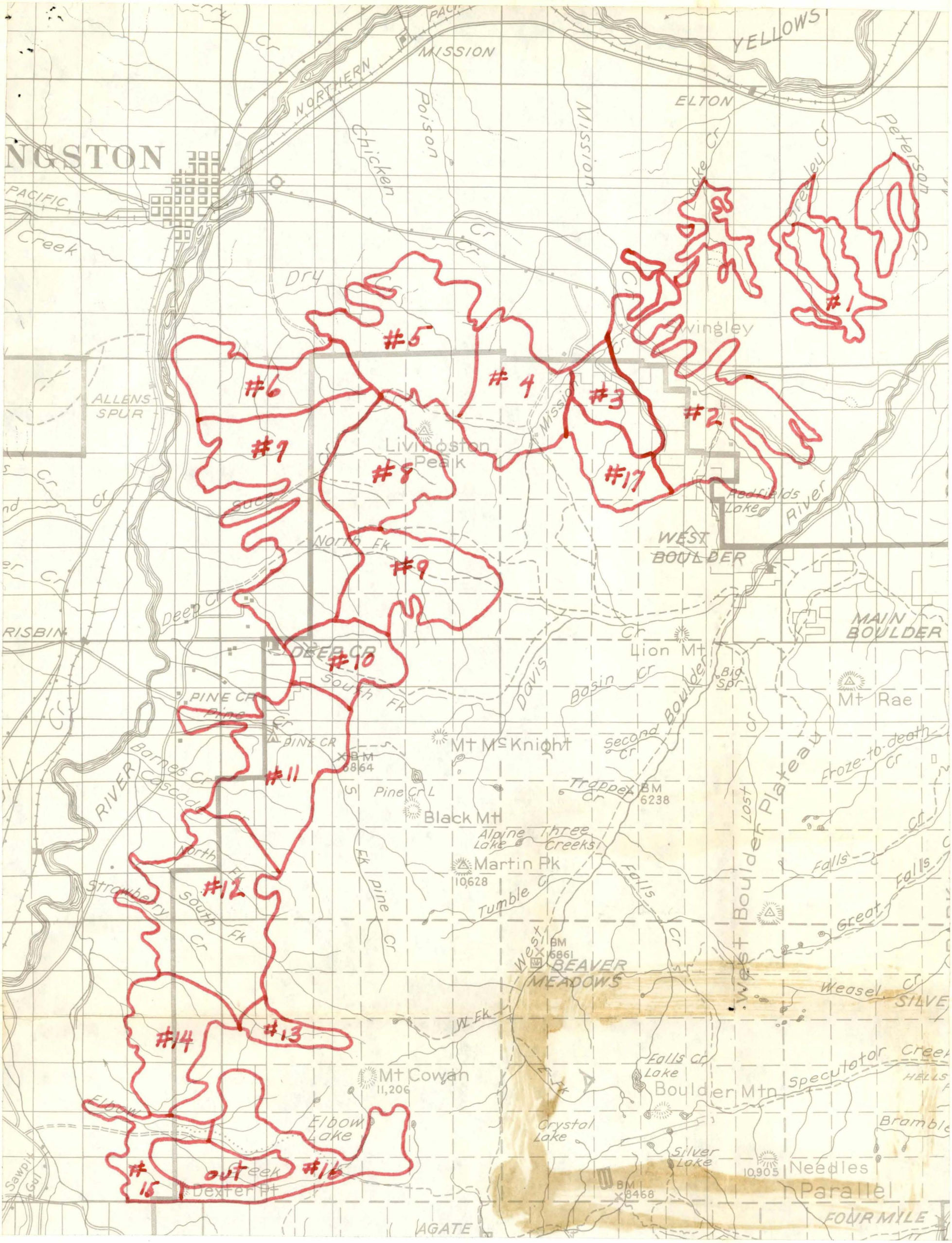
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GALLATIN RIVER BLOCK
GALLATIN UNIT
SPRUCE BUDWORM CONTROL
1960